CHARACTERISTICS OF THINNED LODGEPOLE PINE STANDS IN FOREST SERVICE REGION 1

FINAL REPORT for Cooperative Agreement
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Study No. 4151-018

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Characteristics of Thinned Lodgepole Pine Stands in Forest Service Region 1

Objectives: The primary objective of this study was to evaluate and document characteristics of thinned lodgepole pine stands (and their adjacent controls) that are implicated in the susceptibility of trees and stands to attack by the mountain pine beetle.

INTRODUCTION

The purpose of this study was to evaluate thinned lodgepole pine stands in Region 1 in terms of characteristics associated with mountain pine beetle attack. Numerous site and stand characteristics have been implicated in susceptibility to beetle infestations. For example, beetle attack has been correlated with elevation and habitat type (site characteristics), and density, diameter, and age (stand characteristics).

METHODS

To achieve the study objective, timber management records from Forest Service Region 1 were screened for thinned lodgepole stands that met the following criteria: 1) predominantly lodgepole pine ($\geq$70 percent composition), 2) thinned between 1970 and 1987, and 3) either adjacent to or near an unthinned stand of similar age, species composition, and site. Preliminary screening was conducted at the ranger district level by the ADOR and district staff most familiar with local conditions. District personnel also provided maps and air photos of candidate stands.

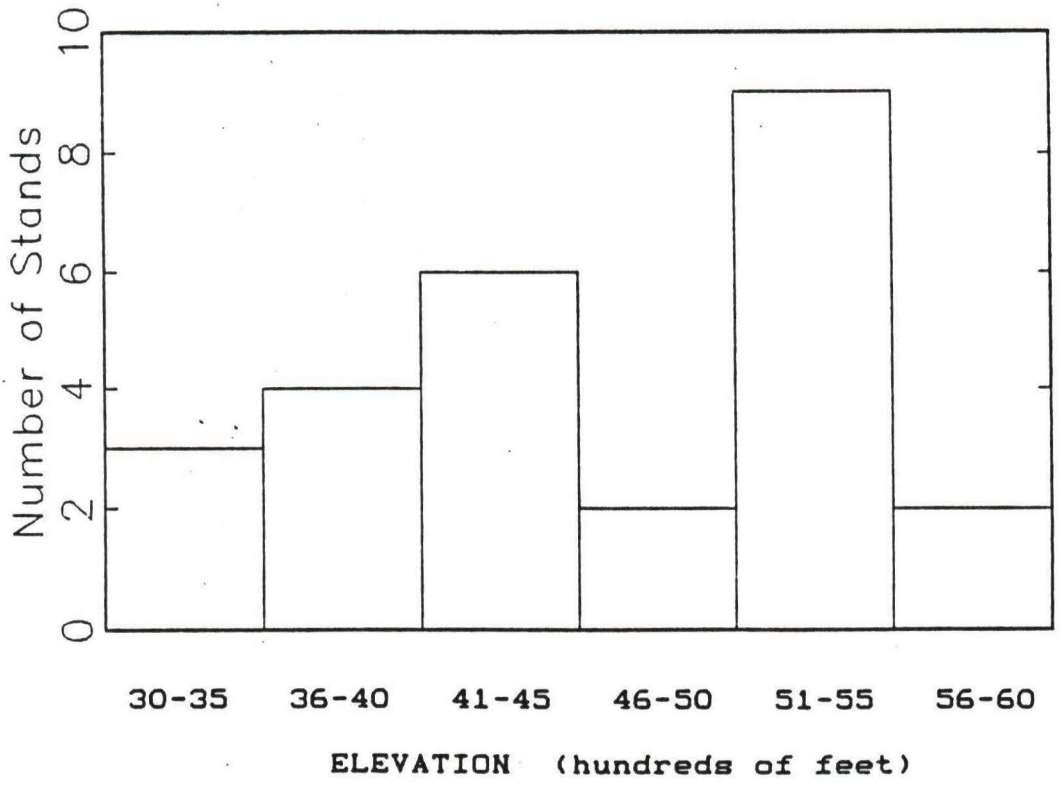
In the second phase of the study, candidate stands selected in the screening process were examined in the field to determine if actual conditions met study requirements (as suggested by timber management records). Elevation, habitat type, density (basal area), average diameter, and age were determined for each of the stands that met study criteria (Appendix A). Boundaries of qualifying stands were flagged, and their location identified by national forest, ranger district, stand number, township, range, section, and quarter section (Appendix B).

Below, the basis for examining the relationship of mountain pine beetle attack relative to elevation, habitat type, density, average diameter, and age is established by citing prior research. In addition, the distribution of the 26 Region 1 study stands is classified in relation to each of these five characteristics (Figures 1-5).

Elevation

Cole and Amman (1976) compiled data collected by Gibson on the Beaverhead and Bitterroot National Forests that showed a strong decline in beetle-caused mortality with increasing elevation. Amman (1973) and Safranyik (1978) reported that mountain pine beetle biology and brood survival were adversely affected by increasingly more severe climates at higher elevations. Consequently, both the frequency and intensity of infestation decrease with elevation (Amman and Baker 1972). Table 1 shows the distribution of thinned stands from this study in relation to elevation.

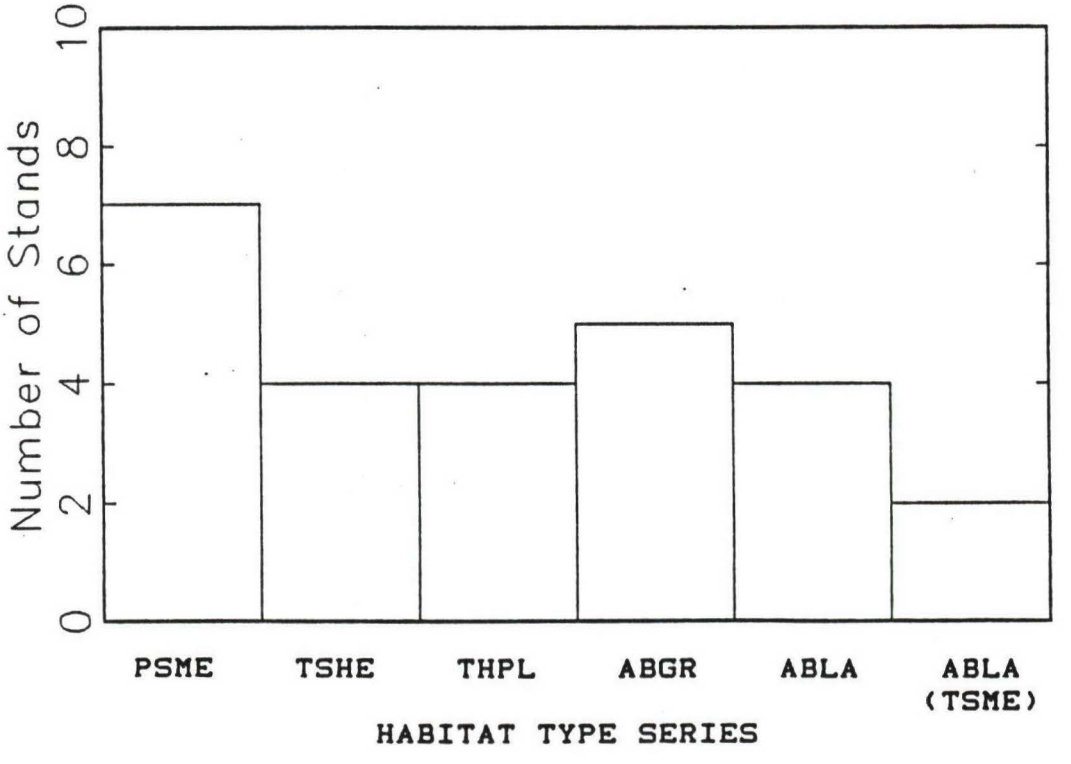
Table 1. Distribution of 26 thinned lodgepole pine stands in Forest Service Region 1 on the basis of elevation.



Habitat type

Intensity of mountain pine beetle attack has also been related to forest habitat types. Roe and Amman (1970) compared beetle-caused mortality within three habitat types in northwest Wyoming and southeast Idaho, and reported the highest levels of mortality within the ABLA/PAMY h.t., intermediate levels within the PSME/CARU h.t., and lowest levels within the ABLA/VASC h.t. McGregor (1978) found that lodgepole pine mortality on the Gallatin NF in Montana was highest on Douglas-fir habitat types, decreased on spruce and subalpine fir habitat types, and was lowest in lodgepole pine climax communities. The distribution of the 26 study stands relative to habitat type series is shown in Table 2.

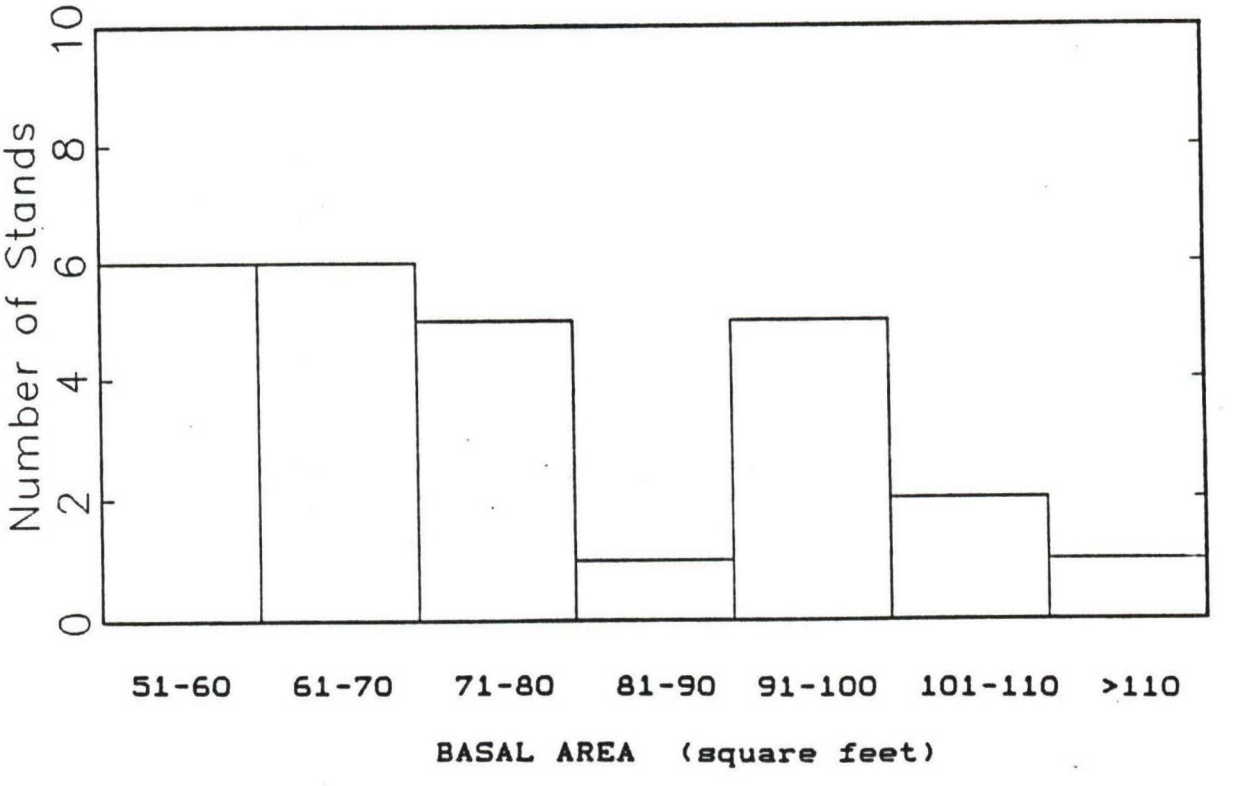
Table 2. Distribution of 26 thinned lodgepole pine stands in Forest Service Region 1 on the basis of habitat type series.



Density

Stand density has also been correlated with beetle-caused mortality. Mitchell et al. (1983) found increased resistance to mountain pine beetle in thinned stands, which they attributed to increased tree vigor at lower stand densities. Waring and Pitman (1985) also reported reduced susceptibility to beetle attack at reduced density levels. Increased resistance was reflected by increased tree growth efficiency. The distribution of thinned stands from Region 1 based on density (basal area) is shown in Table 3.

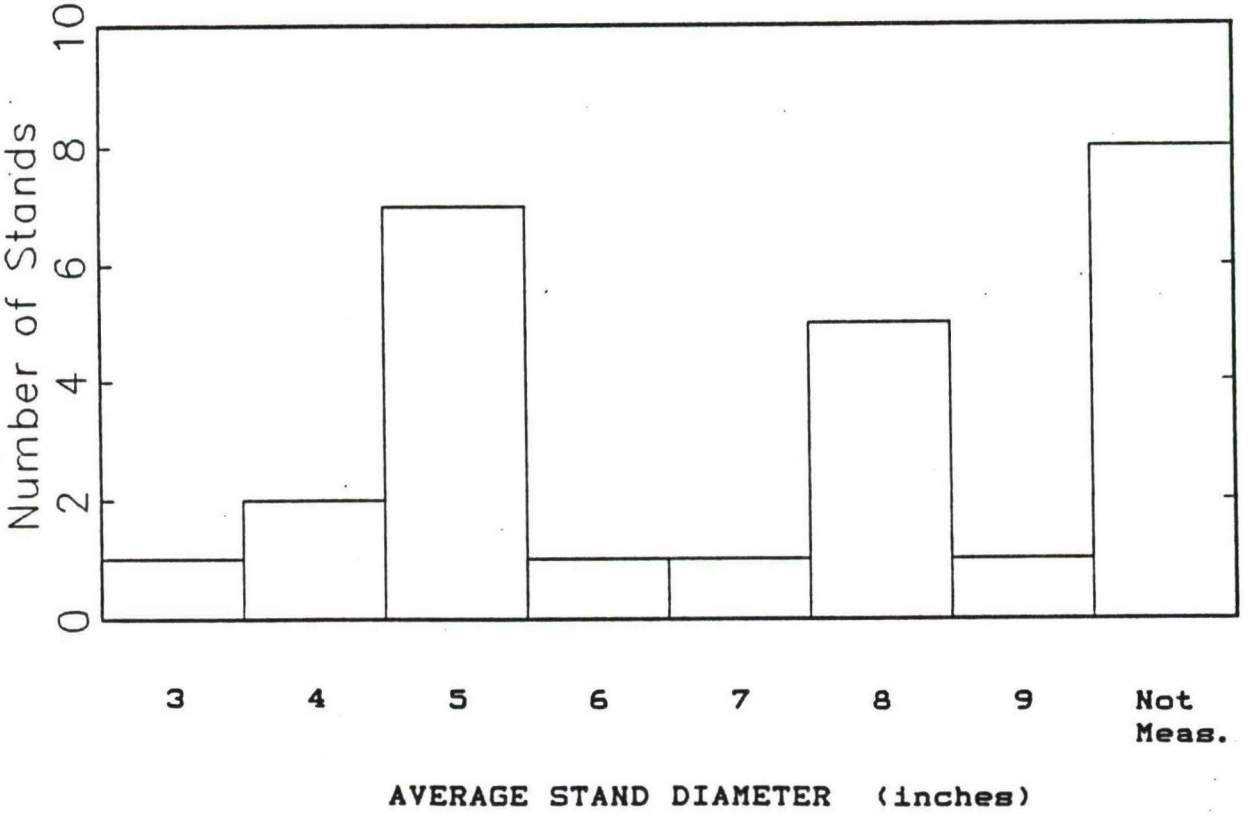
Table 3. Distribution of 26 thinned lodgepole pine stands in Forest Service Region 1 on the basis of basal area.



Diameter

Intensity of mountain pine beetle infestation has also been associated with tree diameter. McGregor and Cole (1985) reported that heavy beetle infestations require at least some trees in a stand larger than 8 inches in diameter. Thicker phloem and higher moisture levels have been established as the factors primarily responsible for greater beetle production in larger-diameter trees (Amman 1969; Cole et al. 1976). Table 4 depicts the distribution of stands from this study on the basis of average diameter.

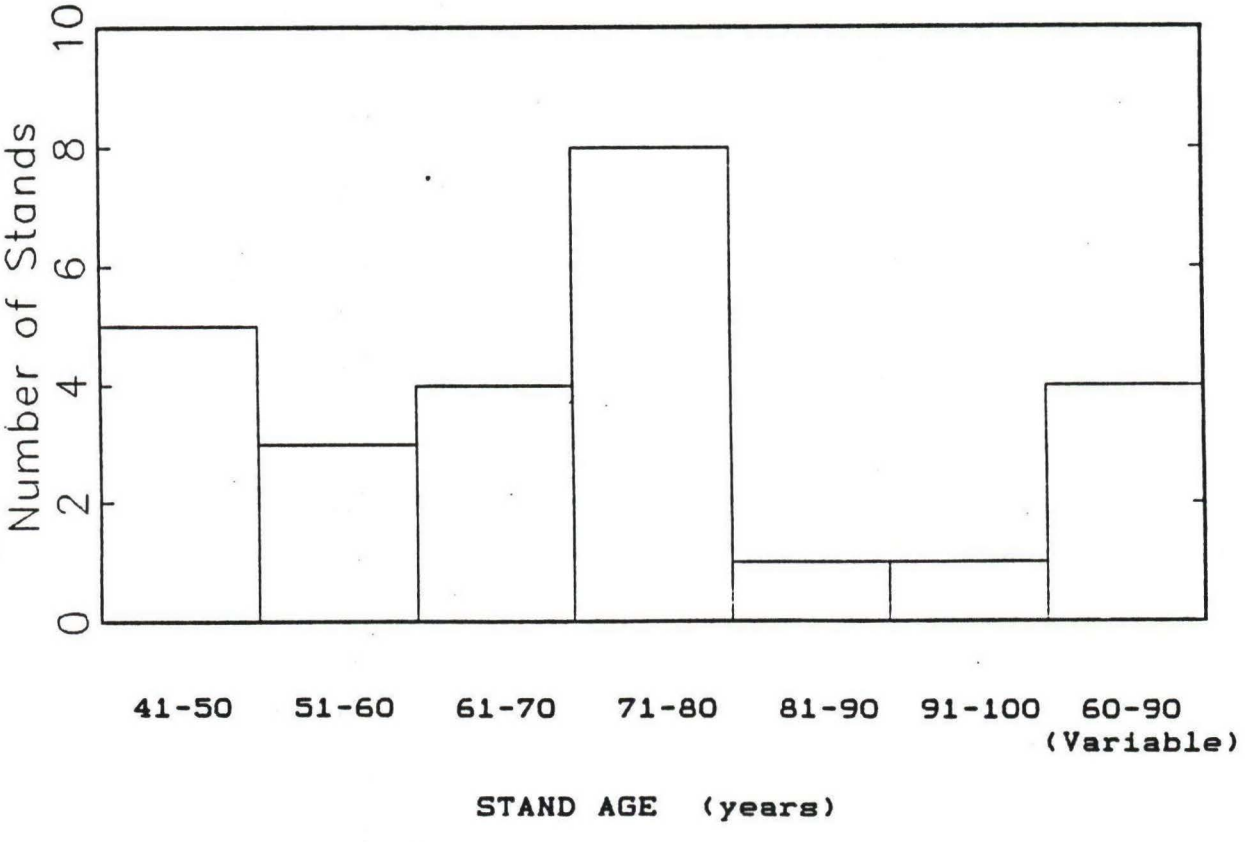
Table 4. Distribution of 26 thinned lodgepole pine stands in Forest Service Region 1 on the basis of average stand diameter.



Age

A strong relationship has been established between beetle infestation and stand age. Outbreaks typically occur in stands about 80 years old (Safranyik et al 1974) -- stands younger than about 60 years old are not capable of sustaining an outbreak (McGregor and Cole 1985). Amman (1978) found that phloem in younger trees is usually spongier and more resinous, perhaps because of lower compression and bigger cells (Cabrera 1978). The distribution of Region 1 thinned stands in terms of age is shown in Table 5.

Table 5. Distribution of 26 thinned lodgepole pine stands in Forest Service Region 1 on the basis of stand age.



APPENDIX A

Site and stand characteristics for 26 thinned lodgepole pine stands in Region 1

Bitterroot NF - Sula RD

Stand 320-5-09 is located at approximately 6000 ft on a PSME/SYAL - CARU h.t. This 75-year-old stand was thinned over a two-year period, 1971 to 1973. Current basal area in the thinned stand is about 60 sq ft. The control lies uphill of the thinned stand.

Stand 96-5-01 lies at about 5600 ft on a ABLA/LIBO - VASC h.t. Age in this stand varied widely -- from 60 to over 90 years. The stand was thinned in 1980, and currently has a basal area density of about 80 sq ft. Lodgepole pine comprises about 75 percent of the stand, with an average stem diameter of about 8 inches. The control is adjacent to the thinned stand.

Stand 96-3-41 is located at 5500 ft elevation on an ABLA/VACA h.t. This stand varies from 60 to over 90 years old, and was thinned in 1980. Residual basal area in the thinned stand is about 75 sq ft. This stand is nearly pure lodgepole pine with a mean diameter of 8 inches (range of 6 to 12 inches). The control lies across the road from the thinned stand.

Stand 96-1-41 occurs at about 5400 ft on an ABLA/VACA h.t. This stand is over 90 years old, with diameters ranging from 6 to 12 inches (mean diameter 8 inches). The stand was thinned in 1980, and currently supports about 100 sq ft of basal area. It is nearly pure lodgepole pine.

Stand 21-3-a and 21-3-b are similar thinned stands. Both stands are located at 5300 ft on a PSME/CARU - ARUV h.t. Both stands were thinned in 1976, and are now about 75 years old. The major difference between the two is that stand 3-a has a density over 95 sq ft, whereas stand 3-b has a density of only 60 sq ft. Both stands have an average diameter of about 8 inches, and both are about 95 percent lodgepole pine. The common control, stand 3-c, lies across the road from the thinned stands.

Idaho Panhandle NF - Avery RD

Stand 230-3-13 lies at 4300 ft on an ABGR/XETE h.t. This 60-year-old stand was thinned in 1978, and supports about 95 sq ft of basal area. Average stand diameter is 5 inches. The control is uphill. This stand can only be reached by a long walk.

Stands 230-3-18 and 230-3-19 are located at 4300 ft elevation on a THPL/CLUN h.t. These 60-year-old stands were thinned in 1978. Stand 3-18 currently has a basal area of 65 sq ft and an average diameter of 5 inches. Stand 3-19 has 90 sq ft of basal area and a mean diameter of 7 inches. In each case, the control is located immediately uphill from the thinned stand. Both stands are accessible only by foot.

Stand 62-2-46 occurs at 4400 ft elevation on a THPL/CLUN h.t. Stand age varies from 60 to over 70 years old, and diameters range from 5 to 8 inches (average diameter 6 inches). The stand was thinned in 1982, and now supports 75 sq ft of basal area. The control is located adjacent to the thinned stand.

Idaho Panhandle NF - Bonners Ferry RD

Stand 20-6-32 is located at about 4000 ft on a TSHE/CLUN h.t. This 40- to 50-year-old stand was thinned in 1983. Basal area density is 70 sq ft, and mean stand diameter is about 3 inches. Species composition is over 80 percent lodgepole pine. The associated control lies just across the road.

Stand 20-7-17 occurs at 3000 ft on a PSME/SYAL h.t. This stand was thinned in 1983, and varies from 40 to 50 years in age. Stand basal area is 75 sq ft, and average diameter is about 4 inches. The stand is about 70 percent lodgepole pine, with the control located across the road.

Stand 27-6-37 is located at 3200 ft on a PSME/CARU h.t. This stand is 40 to 50 years old, and was thinned in 1979. Basal area density is 55 sq ft, and average stand diameter is 6 inches. The stand is over 80 percent lodgepole pine, and the control lies directly across the road.

Stand 33-2-29 lies at 3700 ft elevation on a PSME/PHMA - PHMA h.t. The stand was thinned in 1987, and ranges in age from 40 to 50 years. Residual basal area is 135 sq ft, average diameter is about 5 inches, and species composition is >80 percent lodgepole pine. The control stand is located south of the thinned stand.

Idaho Panhandle NF - St. Maries RD

Stand 428-3-09 is located at about 3000 ft elevation on a TSHE/CLUN - CLUN h.t. This stand was thinned in 1985, and is 40+ years old. Basal area density is 65 sq ft, and mean stand diameter is about 9 inches. This stand is over 90 percent lodgepole pine. The control lies west of the thinned unit.

Idaho Panhandle NF - Wallace RD

Stand 117-1-03 occurs at 5400 ft on a TSME/XETE h.t. This stand was thinned in 1982, and now supports 95 sq ft of basal area. Stand age is about 80 years, and average diameter is 5 inches. Lodgepole pine comprises over 90 percent of the stand. The control is adjacent to the thinned stand.

Stand 17-4-01 is located at 4800 ft on a TSME/XETE h.t. This 70- to 80-year-old stand was thinned in 1982. Stand basal area is about 105 sq ft, and average diameter is about 4 inches. Species composition is over 80 percent lodgepole pine. The control stand is adjacent to the thinned unit.

Stand 19-1-10 is located at about 5200 ft elevation on a ABGR/XETE h.t. Thinning in this 80-year-old stand was accomplished in 1982. Residual basal area is 60 sq ft, and mean diameter is 5 inches. This stand is over 80 percent lodgepole pine. The associated control lies below the thinned stand.

Stand 19-1-14 lies at 5100 ft on a THPL/ATFI h.t. This 80-year-old stand was thinned in 1982. Basal area density is now 60 sq ft, and average diameter is about 5 inches. Over 80 percent of the stand is comprised of lodgepole pine. The control stand lies just below the thinned unit.

Stand 50-3-104 is located at 3600 ft on a TSHE/CLUN h.t. Stand age is about 80 years, and average diameter is 5 inches. This stand was thinned in 1984, and now supports 100 sq ft of basal area. Species composition is over 90 percent lodgepole pine. The control stand is adjacent to the thinned stand.

Kootenai NF - Cabinet RD

Stand 722-7-02 is located at 5000 ft elevation on a ABGR/XETE h.t. This 60- to 80-year-old stand was thinned in 1978. Current basal area density is about 80 sq ft. The control is located across the road from the thinned unit.

Stand 30-1-11 lies at about 4000 ft on a TSHE/CLUN h.t. This stand, which varies in age from 60 to 80 years, was thinned in 1978. Residual basal area is 70 sq ft. The control lies across the road from the thinned unit.

Stand 37-6-08 is located at 5200 ft on a ABLA/MEFE h.t. This 70-year-old stand was thinned in 1978. The basal area density is now about 70 sq ft. The control area is located across the road and below the thinned area.

Lolo NF - Superior RD

Stand 63-2-08 is located at about 4400 ft elevation on a PSME/LIBO h.t. This stand was thinned in 1984, and is now 70 years old. Residual basal area is about 70 sq ft. The control unit is located directly uphill from the thinned unit.

Nez Perce NF - Elk City RD

Stand 819-3-61 is situated at about 4500 ft on a ABGR/XETE h.t. This 60- to 70-year-old stand was thinned during the period 1985 to 1986. Basal area density of this stand is now about 60 sq ft. The control is nearby (see map).

Stand 21-4-50 lies at 5400 ft on a ABGR/XETE h.t. This stand ranges in age from 75 to 85 years, and was thinned in 1987. Basal area density is now about 110 sq ft. The control lies to the south of the thinned unit.

APPENDIX B

Administrative identification and legal description of 26 thinned lodgepole pine stands in Region 1.

National Forest	Ranger District	Stand No.	Township	Range	Section	1/4
Beaverhead	Wise River	--	No suitable stands			
Bitterroot	Stevensville	--	No suitable stands			
Bitterroot	Sula	320-5-09	T2N	R17W	36	N1/2
		96-5-01	T3N	R17W	34	W1/2
		96-3-41	T2N	R17W	4	SE1/4
		96-1-41	T2N	R17W	4	SE1/4
		21-3-a,b,c	T2N	R17W	16	N1/2
Clearwater	Lochsa	--	No suitable stands			
	Pierce	--	No suitable stands			
	Powell	--	No suitable stands			
Idaho Panhandle	Avery	230-3-13	T45N	R7E	3	
		30-3-18	T45N	R7E	3	
		30-3-19	T45N	R7E	3	
		62-2-46	T46N	R4E	24	SE1/4
Idaho Panhandle	Bonners Ferry	720-7-02	T64N	R1E	23	N1/2
		20-7-17	T64N	R1E	21	NE1/4
		27-6-37	T64N	R1E	3	N1/2
		33-2-29	T64N	R1E	23	S1/2
Idaho Panhandle	Fernan	--	No suitable stands			
Idaho Panhandle	Priest Lake	--	No suitable stands			
Idaho Panhandle	Sandpoint	--	No suitable stands			
Idaho Panhandle	St. Maries	428-3-09	T42N	R1E	3	S1/2

Idaho Panhandle	Wallace	117-1-03	T48N	R4E	32	SE1/4
		17-4-01	T47N	R4E	13	E1/2
		19-1-10	T48N	R3E	36	NE1/4
		19-1-14	T48N	R3E	25	SW1/4
		50-3-104	T51N	R4E	29	SW1/4
Kootenai	Cabinet	722-7-02	T25N	R33W	14	S1/2
		30-1-11	T22N	R32W	23	NW1/4
		37-6-08	T24N	R29W	14	N1/4
Lolo	Superior	63-2-08	T16N	R24W	31	W1/2
Nez Perce	Elk City	819-3-61	T28N	R9E	5	S1/2
		21-4-50	T28N	R8E	28	

LITERATURE CITED

Amman, G. D. 1969. Mountain pine beetle emergence in relation to depth of lodgepole pine bark. USDA For. Serv. Res. Note INT-96. 8p.

_____. 1973. Population changes of the mountain pine beetle in relation to elevation. Environ. Entomol. 2:541-547.

_____. 1978. The biology, ecology and causes of outbreaks of the mountain pine beetle in lodgepole pine forests. p. 39-53 In: Theory and practice of mountain pine beetle management in lodgepole pine forests. Symp. Proc. Berryman, A. A., Amman, G. D., and R. W. Stark, eds. Univ. of Idaho, Moscow.

_____ and Baker, B. H. 1972. Mountain pine beetle influence on lodgepole pine stand structure. J. For. 70:204-209.

Cabrera, H. 1978. Phloem structure and development in lodgepole pine. p. 54-63 In: Theory and practice of mountain pine beetle management in lodgepole pine forests. Symp. Proc. Berryman, A. A., Amman, G. D., and R. W. Stark, eds. Univ. of Idaho, Moscow.

Cole, W. D., Amman, G. D. and C. E. Jensen. 1976. Mathematical models for the mountain pine beetle-lodgepole pine interaction. J. Environ. Entomol. 5:11-19.

_____ and G. D. Amman. 1980. Mountain pine beetle dynamics in lodgepole pine forests. Part I: course of an infestation. USDA For. Serv. Gen. Tech. Rept. INT-89. 56 p.

McGregor, M. D. 1978. Management of mountain pine beetle in lodgepole pine stands in the Rocky Mountain area. p. 129-139 In: Theory and practice of mountain pine beetle management in lodgepole pine forests. Symp. Proc. Berryman, A. A., Amman, G. D., and R. W. Stark, eds. Univ. of Idaho, Moscow.

_____ and D. M. Cole. 1985. Integrating management strategies for the mountain pine beetle with multiple-resource management of lodgepole pine forests. USDA For. Serv. Gen. Tech. Rept. INT-174. 68 p.

Mitchell, R. G., Waring, R. H. and Pitman G. B. 1983. Thinning lodgepole pine increases the vigor and resistance to mountain pine beetle. For. Sci 29:204-211.

Roe, A. L. and G. D. Amman. 1970. The mountain pine beetle in lodgepole pine forests. USDA For. Serv. Res. Pap. INT-71. 23 p.

Safranyik, L., Shrimpton, D. M. and H. S. Whitney. 1974. Management of lodgepole pine to reduce losses from the mountain pine beetle. Can. Dept. Environ. For. Serv., Pacific For. Res. Centre. Tech. Rept. 1. 24 p.

_____. 1978. Effects of climate and weather on mountain pine beetle populations. p. 77-86. In: Theory and practice of mountain pine beetle management in lodgepole pine forests. Symp. Proc. Berryman, A. A., Amman, G. D., and R. W. Stark, eds. Univ. of Idaho, Moscow.

Waring, R. H. and G. B. Pitman. 1985. Modifying lodgepole pine stands to change susceptibility to mountain pine beetle attack. Ecol. 66:889-897.